What is claimed:

1. In a scanned probe microscope apparatus having a probe and a scanning head arranged for operative engagement of a surface of a sample for measuring a surface topography thereof, the improvement comprising:

a. said probe having a hardness greater than a sample to be tested;

b. a force sensor operatively located to measure the force between said sample and said probe, said force sensor having an output signal, wherein said force sensor includes,

i. a pair of capacitive transducers, each transducer including a separate drive plate, the first of said drive plates having a hole centrally disposed therethrough, and a shared pickup plate, said pickup plate positioned between said separate drive plates and separated from each drive plate by an insulating spacer, said drive plates having spaced opposing conductive surfaces when said pickup plate is mounted therebetween, said pickup plate further including a conductive central plate suspended by spring means between said drive plates, wherein said central plate is capable of

39

deflection between the conductive surfaces of each of said drive plates; and

ii. means for transmitting force from a point remote from said central plate to said central portion; and

c. means for measuring the output signal of said force sensor and utilizing said output signal to control a vertical movement of said piezo actuated head to maintain a constant force on a sample as said surface topography is measured.

2. The apparatus of claim 1, wherein said scanning head has a piezo actuated head having said probe mounted thereon and said force sensor is mounted on a fixed base.

3. The apparatus of claim 1, wherein said probe is mounted on said force sensor and said sample is mounted on said scanning head.

4. The apparatus of claim 1, wherein said probe is mounted on said sensor and said sensor is further mounted on said scanning head for operatively engaging said sample on a fixed surface.

5. The apparatus of claim 1, wherein said probe is mounted on a fixed surface, and said sample is mounted on said force sensor, which is mounted on a scanning head for operative engagement with said probe.

6. The apparatus of claim 1, further comprising means

for applying a downward force to said probe, wherein said force sensor measures said force and said means for measuring the output signal of said force sensor converts said output signal during an indentation test.

7. The apparatus of claim 1, wherein said probe comprises a diamond tip.

8. The apparatus of claim 1, wherein said spaced opposing conductive surfaces of said drive plates each have a generally rectangular metalized pattern disposed centrally thereon with an unmetalized perimeter, said metalized patterns coincidentally aligned.

9. The apparatus of claim 8, further comprising an unmetalized portion on the opposing conductive surface of said second drive plate approximating the size and shape of said hole in said first drive plate and aligned therewith.

10. The apparatus of claim 1, wherein said pickup plate includes an etched metal layer supported by a suspension system defined by a pattern of slits cut through said etched metal layer.

11. The apparatus of claim 1, wherein said means for transmitting force includes a non-conductive stem passing through said centrally disposed hole in said first drive plate and in contact with the surface of said pick-up plate approximately at a center point of said pick-up plate.

12. The apparatus of claim 1, wherein said means for transmitting force includes a non-conductive pedestal, said

pedestal having a stem portion passing through said centrally disposed hole in said first drive plate and in contact with the surface of said pick-up plate approximately at a center point of said central plate, wherein said pedestal transmits a force applied to said pedestal to said central plate with resulting deflection of said central plate as it is suspended.

13. In a scanned probe microscope apparatus having a probe and a scanning head arranged for operative engagement of a surface of a sample for measuring a surface topography thereof, the improvement comprising:

a. said probe having a hardness greater than a sample to be tested;

b. a force sensor operatively located to measure the force between said sample and said probe, said force sensor having an output signal, wherein said force sensor includes,

i. a first substrate layer having a metalized inner and a metalized outer surface, said metalized outer surface defining a first exterior surface of said sensor element and said metalized inner surface including a first plate of a first variable capacitor, said first plate further having a hole centrally disposed therethrough;

ii. a second substrate layer including an

insulating layer, said second substrate layer having an open central portion, said second substrate layer further having a first and second surface, said first surface mounted in planar contact with said inner surface of said first substrate layer;

iii. a third substrate layer having a first and second surface, said first surface mounted in planar contact with said second surface of said second substrate layer, said third substrate layer made from a conducting material and having a central plate which is suspended by spring means;

iv. a fourth substrate layer including an insulating layer, said fourth substrate having an open central portion, said fourth substrate layer further having a first and second surface, said first surface mounted in planar contact with said second surface of said third substrate layer;

v. a fifth substrate layer having a metalized inner and a metalized outer surface, said metalized outer surface defining a second exterior surface of said sensor element and said metalized inner surface forming a first plate of a second variable capacitor, said

inner surface of said fifth substrate mounted in planar contact with said second surface of said fourth substrate; and

vi. means for transmitting force from a point remote from said central plate to said central plate; and

c. means for measuring the output signal of said force sensor and utilizing said output signal to control a vertical movement of said piezo actuated head to maintain a constant force on a sample as said surface topography is measured.

14. The apparatus of claim 13, wherein said scanning head has a piezo actuated head having said probe mounted thereon and said force sensor is mounted on a fixed base.

15. The apparatus of claim 13, wherein said probe is mounted on said force sensor and said sample is mounted on said scanning head.

16. The apparatus of claim 13, wherein said probe is mounted on said sensor and said sensor is further mounted on said scanning head for operatively engaging said sample on a fixed surface.

17. The apparatus of claim 13, wherein said probe is mounted on a fixed surface, and said sample is mounted on said force sensor, which is mounted on a scanning head for operative engagement with said probe.

18. The apparatus of claim 13, further comprising

means for applying a downward force to said probe, wherein said force sensor measures said force and said means for measuring the output signal of said force sensor converts said output signal during an indentation test.

19. The apparatus of claim 13, wherein said probe comprises a diamond tip.

20. The apparatus of claim 13, wherein the inner surfaces of said first and said fifth substrate layer each have a generally rectangular metalized pattern disposed centrally thereon with an unmetalized perimeter, said metalized patterns being coincidentally aligned as mounted.

21. The apparatus of claim 20, further comprising an unmetalized portion on the inner surface of said fifth plate approximating the size and shape of said hole in said first substrate and being aligned therewith as mounted.

22. The apparatus of claim 13, wherein said third substrate layer includes an etched metal layer supported by a suspension system defined by a pattern of slits cut through said etched metal layer.

23. The apparatus of claim 13, wherein said means for transmitting force includes a non-conductive stem passing through said centrally disposed hole in said first substrate layer and in contact with the first surface of said third substrate layer proximate the center point of said central plate.

24. The apparatus of claim 13, wherein said means for

transmitting force includes a non-conductive pedestal, said pedestal having a stem portion passing through said centrally disposed hole in said first substrate layer and in contact with the first surface of said third substrate layer proximate the center point of said central plate, wherein said pedestal transmits a force applied to said pedestal to said central plate with resulting deflection of said central plate as it is suspended.

25. In a scanning tunneling microscope apparatus having a base for mounting a sample thereon and a piezo actuated head having a probe mounted thereon for operative engagement of a sample mounted on said base for measuring a surface topography, the improvement comprising:

a. a probe having a hardness greater than a sample to be tested mounted on said piezo actuated head;

b. a force sensor mounted on said base for mounting a sample, said force sensor having an output signal, wherein said force sensor includes,

i. a pair of capacitive transducers, each transducer including a separate drive plate, the first of said drive plates having a hole centrally disposed therethrough, and a shared pickup plate, said pickup plate positioned between said separate drive plates and separated from each drive plate by an insulating

spacer, said drive plates having spaced opposing conductive surfaces when said pickup plate is mounted therebetween, said pickup plate further including a conductive central plate suspended by spring means between said drive plates, wherein said central plate is capable of deflection between the conductive surfaces of each of said drive plates; and

ii. means for transmitting force from a point remote from said central plate to said central portion; and

c. means for measuring the output signal of said force sensor and utilizing said output signal to control a vertical movement of said piezo actuated head to maintain a constant force on a sample as said surface topography is measured.

26. The apparatus of claim 25, further comprising means for applying a downward force to said probe, wherein said force sensor measures said force and said means for measuring the output signal of said force sensor converts said output signal during an indentation test.

27. The apparatus of claim 25, wherein said probe comprises a diamond tip.

28. The apparatus of claim 25, wherein said spaced opposing conductive surfaces of said drive plates each have a generally rectangular metalized pattern disposed centrally thereon with an unmetalized perimeter, said metalized patterns coincidentally aligned.

29. The apparatus of claim 28, further comprising an unmetalized portion on the opposing conductive surface of said second drive plate approximating the size and shape of said hole in said first drive plate and aligned therewith.

30. The apparatus of claim 25, wherein said pickup plate includes an etched metal layer supported by a suspension system defined by a pattern of slits cut through said etched metal layer.

31. The apparatus of claim 25, wherein said means for transmitting force includes a non-conductive stem passing through said centrally disposed hole in said first drive plate and in contact with the surface of said pick-up plate approximately at a center point of said pick-up plate.

32. The apparatus of claim 25, wherein said means for transmitting force includes a non-conductive pedestal, said pedestal having a stem portion passing through said centrally disposed hole in said first drive plate and in contact with the surface of said pick-up plate approximately at a center point of said central plate, wherein said

pedestal transmits a force applied to said pedestal to said central plate with resulting deflection of said central plate as it is suspended.

33. In a scanning tunneling microscope apparatus having a base for mounting a sample thereon and a piezo actuated head having a probe mounted thereon for operative engagement of a sample mounted on said base for measuring a surface topography, the improvement comprising:

a. a probe having a hardness greater than a sample to be tested mounted on said piezo actuated head;

b. a force sensor mounted on said base for mounting a sample, said force sensor having an output signal, wherein said force sensor includes,

i. a first substrate layer having a metalized inner and a metalized outer surface, said metalized outer surface defining a first exterior surface of said sensor element and said metalized inner surface including a first plate of a first variable capacitor, said first plate further having a hole centrally disposed therethrough;

ii. a second substrate layer including an insulating layer, said second substrate layer having an open central portion, said second substrate layer further having a first and second surface, said first surface mounted in

planar contact with said inner surface of said first substrate layer;

iii. a third substrate layer having a first and second surface, said first surface mounted in planar contact with said second surface of said second substrate layer, said third substrate layer made from a conducting material and having a central plate which is suspended by spring means;

iv. a fourth substrate layer including an insulating layer, said fourth substrate having an open central portion, said fourth substrate layer further having a first and second surface, said first surface mounted in planar contact with said second surface of said third substrate layer;

v. a fifth substrate layer having a metalized inner and a metalized outer surface, said metalized outer surface defining a second exterior surface of said sensor element and said metalized inner surface forming a first plate of a second variable capacitor, said inner surface of said fifth substrate mounted in planar contact with said second surface of said fourth substrate; and

vi. means for transmitting force from a

point remote from said central plate to said central plate; and

c. means for measuring the output signal of said force sensor and utilizing said output signal to control a vertical movement of said piezo actuated head to maintain a constant force on a sample as said surface topography is measured.

34. The apparatus of claim 33, further comprising means for applying a downward force to said probe, wherein said force sensor measures said force and said means for measuring the output signal of said force sensor converts said output signal during an indentation test.

35. The apparatus of claim 33, wherein said probe comprises a diamond tip.

36. The apparatus of claim 33, wherein the inner surfaces of said first and said fifth substrate layer each have a generally rectangular metalized pattern disposed centrally thereon with an unmetalized perimeter, said metalized patterns being coincidentally aligned as mounted.

37. The apparatus of claim 36, further comprising an unmetalized portion on the inner surface of said fifth plate approximating the size and shape of said hole in said first substrate and being aligned therewith as mounted.

38. The apparatus of claim 33, wherein said third substrate layer includes an etched metal layer supported by

a suspension system defined by a pattern of slits cut through said etched metal layer.

39. The apparatus of claim 33, wherein said means for transmitting force includes a non-conductive stem passing through said centrally disposed hole in said first substrate layer and in contact with the first surface of said third substrate layer proximate the center point of said central plate.

40. The apparatus of claim 33, wherein said means for transmitting force includes a non-conductive pedestal, said pedestal having a stem portion passing through said centrally disposed hole in said first substrate layer and in contact with the first surface of said third substrate layer proximate the center point of said central plate, wherein said pedestal transmits a force applied to said pedestal to said central plate with resulting deflection of said central plate as it is suspended.

Add A3